Mathematical Patterning Activities in the Early Grades

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Abstract: *This article discusses the importance of patterning in early mathematics study for young children and describes some patterning activities for prekindergarten classes to motivate young children to explore the mathematics through observing and creating their own patterns.*

Keywords. *Patterning activities, young children, early childhood educator*

1 Introduction

Early childhood mathematics interventions are widely regarded as an opportunity to help young children to achieve developmental milestones in mathematical knowledge (Clements & Sarama, 2011). The authors of Principles and Standards for School Mathematics (NCTM) advocate for the importance of patterning for algebra learning and require all students to understand patterns, relations, and functions (NCTM, 2000, p. 37). The patterning outcomes expected for children from prekindergarten to second grade include the ability to "(i) recognize, describe, and extend patterns, and (ii) analyze how both repeating and growing patterns are generated (NCTM, 2000, p. 90). In fact, patterning is fundamental to mathematics, especially in the area of algebra. Accurately identifying similar or different patterns, discovering their relationships, creating new rules, and eventually utilizing mathematical symbols to describe their logical relations promotes algebraic thinking in young children (McGarvey, 2013).

When a baby is born, he/she is unconsciously involved in a world filled with different kinds of patterns. With the parents' soft voices and gentle touches, the little baby gradually stops crying and falls asleep in their arms. In fact, the series of parent behaviors establish the basic concept of patterning in little children. For instance, a light pat on the back of infants and a rhythmic lullaby produce repeating patterns when parents are soothing their babies to get them to sleep. Zentner and Eerola (2010) found that young children from newborns to toddlers are able to find patterns in lullaby songs and hear them in the music. For instance, the famous lullaby "Hush, little baby" has a rhythmic pattern that appeases babies' cries.

Mom:	Hush, little baby, don't you cry, . . .,			Hush, little baby, don't you cry		
Pattern:	A	B	C	A	B	C

When parents repeatedly pat the back of a baby, along with rocking him/her in a chair, the baby also can feel the patterning, such as ABAB or ABCABC. The primary patterning experience not only incorporates the concept of emergent mathematics, but also promotes their mathematical patterning study in the classroom (Geist, Geist, & Kuznik, 2012).

2 Introducing the Concept of Patterning in Daily Classroom Routines

As a Montessori certified teacher, I have been teaching four-year-old and six-year-old early math for almost three years. Young children have a strong predisposition toward learning things (Piaget, 1973). Since the first day I walked into my classroom, I wondered how to incorporate early mathematical concepts into daily routines and stimulate young children's motivation to solve problems on their own instead of forcing them to mechanically memorize geometric shapes and abstract numbers.

The concept of pattern is an underlying theme of early mathematics. The ability of young children to distinguish and utilize patterns is a valuable problem solving skill, and it has a deep effect on the development of logical mathematical thinking. In order to introduce patterning activities, I implemented patterning concepts during morning greeting circle time. I placed children's name tags on the carpet to make a circular pattern in the sequence of boy-girl-boy-girl. Through identifying their photos on their name tags, children can find their own spots. At the beginning, the majority of young children were unable to read the pattern sequence with my clues. One day, I invited all of children to play a rhythmic clapping game with me. They followed me in raising their hands and doing the same patterning action, such as clap-snap-clap-snap-clap-snap, or clap-stomp-clap-stomp-clap-stomp. During the process of the activity, the children were willing to create their own pattern.

BOY 1: Ms. Wang, I can make this like clap-clap-snap-snap-clap-clap-snap-snap. Do you think this is good?
ME: Wonderful! You are so great! Do you know what we have been doing for the last few days?
BOY: (He shook his head.)
ME: Lets give it a name: pattern. What do you think?
CHILDREN: What is pattern?
ME: Pattern is like a repeating rhythm. Clap-snap-clap-snap. Do you know what we are repeating?
GIRL: Yes, I know. We repeat clap and snap. Is this a pattern?
ME: Great! It is a pattern.
BOY 2: Ms. Wang, I can see a pattern in here. Boy-girl-boy-girl-boy-girl-boy-girl-boy-girl-boy-girl-boy-girl-boy, Am I right?
ME: Perfect!

Additionally, I also created a calendar pattern board for young children to figure out what pattern we were supposed to put up on there. I left a blank space underneath the day number. I introduced ABAB repeating pattern with colorful leaves (red-green-red-green), geometric shapes (circle-square-circle-square), emotional faces (happy-sad-happy-sad). During the daily routine, my children were very willing to participate in various patterning activities. They loved to figure out the missing pattern without help, and they were also interested in inventing their own patterns, which increased their interest in future mathematical study at formal schools.

3 Patterning Lessons in the Early Mathematical Classroom

"Patterning is an essential skill in early mathematics learning, particularly in the development of spatial awareness, sequencing and ordering, comparison and classification. This includes the ability to identify and describe attributes of objects and similarities and differences between them" (Papic, 2007, p. 8). In my classroom, I introduced three types of patterning lessons, specifically focusing on linear repeating patterns, hopscotch patterns, and growing patterns. All of these lessons are designed to provide patterning practice from simple and one-dimensional form to complex and

multi-dimensional repetition. According to the ages and problem-solving ability in young children, I presented different degrees of difficulty in patterning activities to them.

3.1 Linear Repeating Pattern Lessons

Linear repeating patterns displayed in a horizontal or vertical orientation present a visual representation of repetition in a unit. A typical linear repeating pattern contains alternating colors or sizes of objects (red-blue or big-small). Before young children are ready to create linear repeating patterns, they should be able to sort out objects on one or two attributes, such as classifying the same color of circles or sorting out the same size of plastic little bears. In the game of making necklaces with small beads and long strings, young children usually have many plastic beads and a string. First, they have to sort out the same color beads. Second, they need to decide what kind of repeating pattern sequence to use, such as ABAB (red-blue-red-blue) or ABCABC (white-yellow-green-white-yellow-green). Third, when they put each bead onto the string, they should follow the repeating rules they create. After they are done and require the teacher to tie a knot at the end of their strings, preschool teachers are responsible for checking how well students make their own patterns, encouraging children to find mistakes if they fail to follow the pattern correctly.

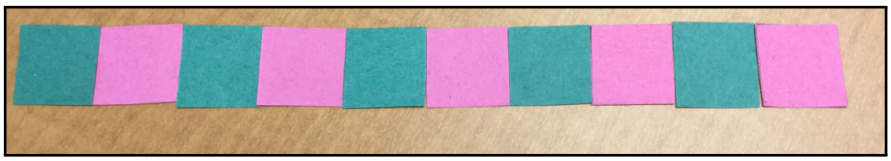

Fig. 1: *An example of linear repeating pattern.*

3.2 Hopscotch Pattern Lessons

Hopscotch pattern tasks aim to develop a child's ability to distinguish a pattern designed with vertical and horizontal objects (Papic, 2007).

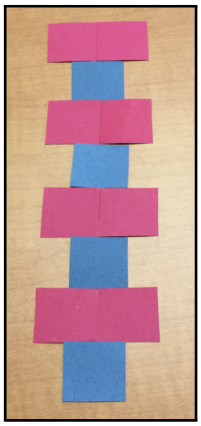

Fig. 2: *An example of hopscotch pattern.*

For example, young children receive two different color squares (red and blue), but the size of all squares is identical. Before children join in the hopscotch pattern task, they should be capable of discerning squares with two dimensions, including the color and the number of squares placed on each orientation. Generally older children (i.e., 5+ years) perform much better than little children. They have to figure out how many squares they place vertically and how many squares they place

horizontally, finally making sure the number and color of squares in each direction are identical. After the child successfully completes this task without any mistakes, he or she can invite friends to play a game of hopscotch. Hopscotch patterns are harder than linear repeating patterns.

3.3 Growing Pattern Lessons

"Growing patterns increase or decrease systematically. They represent variation of one data set, where the relationship between successive terms within the pattern can be identified" (Papic, 2007, p. 12).

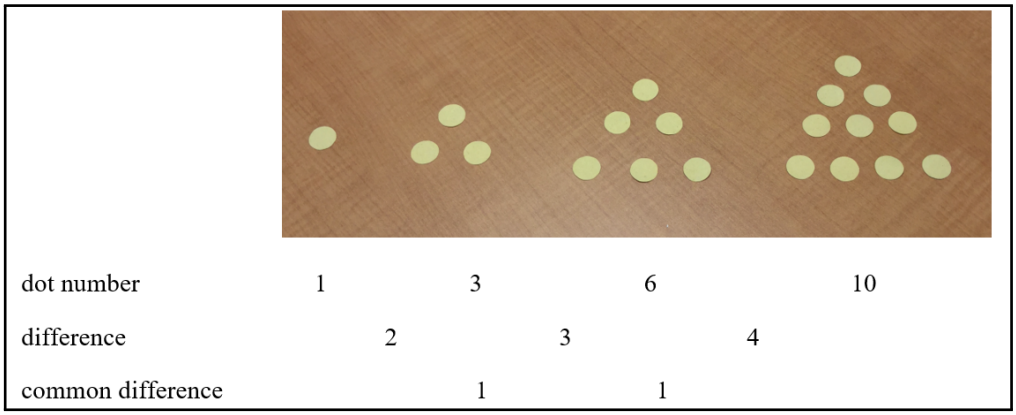

Fig. 3: *An example of a triangle growing pattern.*

The picture shown in Figure 3 presents a growing triangle pattern that displays the number of dots (1, 3, 6, 10). According to the increase of dot numbers, high school students are more likely to find out the differences between the nearest two numbers are 2, 3, 4, . . . which presents an arithmetic sequence in mathematics, because their common difference is 1. Based on the sequence of these numbers, it is easy to figure out how many dots are placed to make next triangle (15, 21, 28. . .). Young children are unable to see the sequence of the set of numbers, but they are expected to see how the triangle grows and try their best to count the number of dots in the triangles. Due to the degree of mastery in early numeracy of young children, early childhood educators can provide the largest triangle with ten dots to them.

The other day, I invited a six-year-old girl to practice growing pattern with me. Below is our conversation.

ME: I have plenty of little dots and Im trying to build something. Would you like to join me?
GIRL: Yes.
ME: Now there is one dot. I place it right here. Now I have a few dots. I put one on top and two underneath. What shape is it now?
GIRL: A triangle. Can I try, please?
ME: Sure. But you need to build the same shape as I just did and your shape has to be bigger than mine. Can you do it?
GIRL: Yes. I want to try. (She picked three dots and did the same thing as I just did. She put one dot on the top and the rest two underneath.) I'm done. (She proudly said.)
ME: Good, but you forget one thing. Your shape should be bigger than mine.
GIRL: Oh, yes. I forgot. (She tried to put two more dots on the third line and she stopped. And then she picked two more dots places beside the previous two and stop again. Last she placed one dot back and rearranged the three dots.) I made a bigger triangle.

ME: Very good. You did it.

The process the girl went through to move dots back and forth demonstrated the way she was thinking about how the growing pattern increased. I suggest that early childhood educators watch children build shapes on their own if they do not ask for help because the thinking process is very important for logical mathematical concepts in their future algebra study.

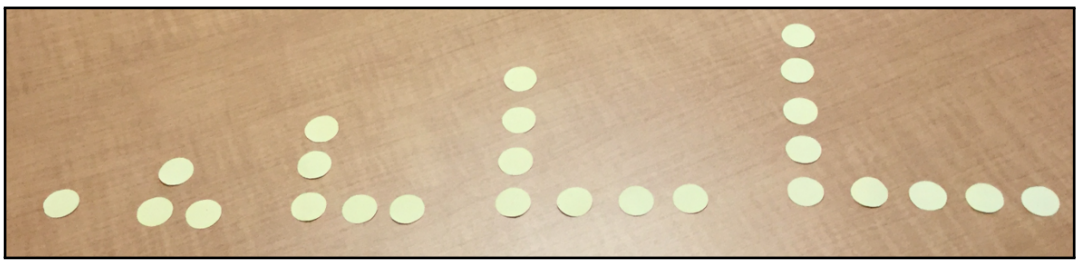

Fig. 4: *An example of a right angle growing pattern.*

For little children, building a right angle is a good activity for them to see how shapes grow and to better understand the concept of growing patterns. Children below five years of age hardly have the ability to solve this problem independently, but they love to observe how adults do it. Early childhood educators can also invite young children to count how many dots each right angle includes.

4 Further Recommendations for Improving Young Children's Understanding of Patterning

Although there are many interesting patterning activities in prekindergarten and kindergarten classrooms to help young children get involved in the mathematical world early, childhood educators have the ability to discern if a child is able to do hopscotch pattern tasks based on his/her experiences of repeating pattern at his/her current age. If young children have a strong understanding of repeating patterning and are able to identify, classify, and create new things on their own, early childhood educators can introduce more challenging patterning activities, such as hopscotch pattern or growing pattern. If young children are unable to accomplish simple, one-attribute patterning tasks, early childhood educators can practice parallel or similar repeating patterning activities with them.

Additionally, early childhood educators can implement multi-modal activities during circle time for children to practice patterning, such as using movement chairs to ask them to create different types of patterns (stand-empty-stand-empty/sit-sit-empty-empty/stand-stand-sit-sit). In our environments, there are plenty of living patterns waiting for young children to discover. Early childhood educators can encourage young children to actively observe and identify patterns, such as patterned carpets down the hall, a patterned block wall in the classroom, and patterned shapes on their clothes or equipment on the playground. During group reading time, preschool teachers can also introduce patterning books to children and let them distinguish what patterns they see in the book and count the number of objects in the picture books.

5 In Conclusion

Children are born in the world of patterns. Infants' initial patterning experiences provide them with a foundation for later algebra study at formal schooling. With development over time, children

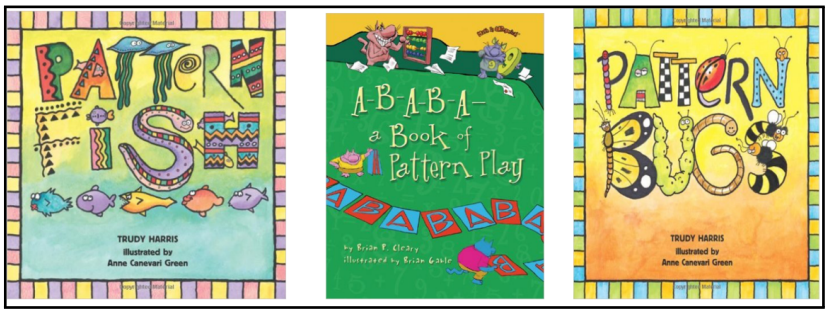

Fig. 5: *Examples of picture books about patterning.*

gradually realize specific relations in things through observing the sequence of different patterns. Curricular expectation for cultivating the ability of patterning problem-solving contributes to algebraic reasoning in young children (McGarvey, 2013). In order to achieve this goal, parents and early childhood educators should be aware of reinforcing patterning activities and facilitating pattern-learning environments both in and out of the classroom.

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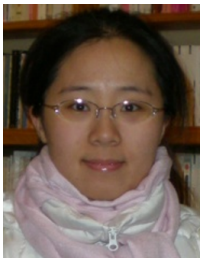

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